

United States about 1880, despite the fact that the general climate is still one of marked expansion. If this downward trend is left unexplained, the reasons for deviations from it are of much less interest.

Professor Thomas devotes much attention to trying to determine whether variations in the flow of migration were more influenced by variations in the "push" of difficulties in Europe or in the "pull" of opportunities in the United States. His conclusion is that in many periods the push factor was more important than has commonly been supposed, and his arguments certainly show that it is an essential part of any explanation. At times, however, the logic of the analysis seems rather insecure. Thus he considers the dates of the turning points in the statistics for American railway-building and for immigration from Britain and Ireland (separately), to see whether a spurt of railway-building stimulated an inflow of migrants (the "pull" thesis) or an inflow of migrants made railway-building possible and profitable shortly afterwards. The first thesis can legitimately be tested with figures for migrants of each nationality separately, since the pull would apply to each country; but the second should be used for *total* immigration, and the "push" thesis would only predict this result for the separate nationalities if pushes were applying simultaneously to each. Again, Professor Thomas takes the *monthly* figures for immigration into the United States and American pig-iron production, and finds what lag gives the highest correlation coefficient; but if one were wishing to test the "pull" thesis one would never suppose that the figures for single months would have any influence on the potential migrant in Europe, quite apart from the difficulty caused by the (varying) lag between his decision to move and his arrival in the United States. Professor Thomas never tackles the awkward problem that the two theses require different variables for their test—arrivals in U.S. for the "push", decisions to depart for the pull; decisions to build railways for the push, railway construction for the pull. But I

suspect that this is a field in which the application of ingenuity soon encounters diminishing returns: the "push" was operating all the time, and its force was sometimes intensified (as Professor Thomas shows well); the pull was also operating all the time, though with varying intensity; the variations do not necessarily divide neatly in either case into "trend", "minor secular fluctuations", etc, and the two factors react on one another—in particular a wave of emigration from one country due to a push will affect the pull for others. The combination of push and pull is what explains the emigration which actually took place—trend, minor secular fluctuations, short cycle and all—and attempts to attribute the fluctuations to changes in one factor rather than another cannot get very far without an equally elaborate explanation of the trend.

This type of criticism should not, however, be allowed to detract from one's recognition of the stimulating initiative which Professor Thomas has shown in tackling a complex of subjects which will repay a great deal of study. One must also admire the way in which he has scrutinized the basis of the statistics which he uses, and provided the reader with no less than 138 clearly described tables with which to check the deductions made—and perhaps produce some of his own.

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BIOLOGY

Mann, T. R. R. *The Biochemistry of Semen*. London, 1954. Methuen. Pp. xiv+240. Price 16s.

THERE are two prerequisites for eugenics: a decision about what we want or do not want in a population, and effective and acceptable techniques for ensuring that when children are required they will be forthcoming and not when they are not. While we are waiting for the first decisions to be made, it would be well if there were progress towards the second prerequisite. This progress will have

personal and æsthetic, as well as eugenic, advantages.

Fuller control over fertility depends on more knowledge about sperm, ova, and the processes of their development and union. In this book Dr. Mann confines himself to an excellent appraisal of what is known about semen. He considers the properties of sperm and the changes undergone during storage and after discharge into the female; he considers the properties of the secretions of the various glands that help in producing semen; but he only considers the metabolism of the testis and of these glands in so far as it is necessary to explain the effects of hormones and other agents on the composition of the semen. He deals only briefly with the effects of sperm on ova. There is obviously a need for further monographs on other aspects of the process of fertilization. A particular merit of this book is the emphasis placed on history. People seldom realize how much Leeuwenhoek, Spallanzani and Meischer observed and how sensible the arguments were that they based on their observations.

Semen is a teleologist's paradise. We think we know just what its function is and so argue about how its properties serve that function. Two difficulties arise: the function may be complex and there are such striking differences in the morphology and composition of sperm in different species, and in the composition of the seminal plasma, as to make it likely that some of these functions are rather trivial. This complicates the design of a contraceptive. Little is gained by finding out how to inhibit a process if it is not essential for fertilization but only improves the chances of it slightly.

The chemical composition of semen offers many surprises. Leeuwenhoek found crystals of spermine phosphate in it and they are still used medico-legally. We now know that spermine comes from the prostate and is a peculiarity of man. Other substances characterize other animals, for example inositol and ergothionine in the abundant semen of the boar. This is a field of research to which Dr. Mann has himself made notable contributions but much of it still remains unexplored.

He approaches questions of function with suitable caution but indulges one speculation: inositol protects tissue cultures from mitotic poisons and may give a protective environment for sperm. This hint might well be followed up to see whether sperm, which are more permeable than most cells, could in the absence of these substances be more easily modified chemically. Differential killing, and so, for example, sex determination, might then be possible and so might directed mutation. The latter would open up new eugenic possibilities.

Biochemical study is essential for a full understanding of sperm. Thus millions are squandered on the fertilization of one ovum but we do not yet know whether most of them get lost, or whether they help each other by maintaining in the neighbourhood of an ovum a more effective concentration of an enzyme or substrate than one sperm would be able to do, or whether even under ideal circumstances only a small proportion would be able to fertilize an ovum. By the crude standards of the morphologist a considerable proportion of abnormal forms is recognizable in most semen samples—the real proportion may be much higher. By analogy with other motile systems it is assumed that the phospho-creatine and phospho-arginine found in sperm play a part in their movement. Interest in this assumption is enhanced by the fact that the usual generalization breaks down here. Phospho-creatine is characteristic of the tissues of vertebrates and phospho-arginine of invertebrates, but each appears to be present in sperm from the other group. This is a matter that deserves closer attention.

Clearly, although Dr. Mann cites about 1,000 references, the investigation of semen is in its infancy. When as much work has been done on it as, for example, on blood it will be more reasonable to think of interpreting the oddities that it presents. Mephistopheles remarked: "Blut ist ein ganz besondrer Saft." Semen is not so well suited for signing documents but socially and biochemically it runs blood a close second.

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